

A New Family of Spiders of the Sub-order Hypochilomorphae

R. R. FORSTER¹

THE SUB-ORDER HYPOCHILOMORPHAE was established by Petrunkevitch in 1933 to include those spiders with diaxial chelicerae which also possessed four lung books. Three species are known viz. *Hypochilus thorelli* Marx, from North America, *Ectatosticta davidi* Simon, from Tibet, and *Ectatosticta troglodytes* (Higg. and Pet.), from Tasmania, which are all included in the family Hypochilidae. The establishment of this sub-order has not met with general agreement among present-day arachnologists, many of whom still group these spiders with the two-lunged cribellate spiders. The occurrence of the two species recorded in the present paper, which do not possess a cribellum seems to strengthen Petrunkevitch's case for the separation of these spiders into a separate sub-order.

The three previously known species share many characters in common. They are long-legged, sedentary spiders which construct extensive webs. They possess relatively small, vertical chelicerae and the poison glands do not extend into the cephalothorax. The genital bulb of the male is terminal, the heart is supplied with four pairs of ostia and they all possess a cribellum.

The two species described below although they possess diaxial chelicerae, two pairs of lung books and four pairs of ostia, differ considerably in other characters from previously known species. In general appearance and habit they resemble lycosid spiders. They are vagrant in habit, hunting their prey on the

forest floor. They do not appear to make any webs or to use silk in any way to snare their food. The chelicerae are strong and directed forward and are provided with large poison glands which extend well into the cephalothorax. The genital bulb of the male is inserted near the middle of the ventral surface of the tarsus of the pedipalp and there is no cribellum present.

In view of the striking differences shown by these two species, particularly the absence of a cribellum, I have considered it advisable to establish a new family for their reception.

Sub-order HYPOCHILOMORPHAE
Petrunkevitch, 1933

Family GRADUNGULIDAE fam. nov.

Ecribellate spiders with non-segmented abdomen. Two pairs of lung books. Diaxial chelicerae, lacking lateral condyles, with endocephalic poison glands. Maxillary lobes well developed, multicellular maxillary glands with ducts opening from a sieve. Six spinnerets with colulus. Three tarsal claws. Tarsus of female pedipalp with strong claw, genital bulb of male pedipalp not terminal. Eight eyes in two rows.

Genus GRADUNGULA gen. nov.

Cephalothorax low, with eight eyes in two rows, A.M.E. smallest. Chelicerae strong, directed forward, promargin with teeth, retro-margin smooth. Maxillary lobes without serrula. Legs 4, 1, 2, 3, tarsal claws of legs 1 and 2 greatly modified; proclaw much longer

¹ Canterbury Museum, Christchurch, New Zealand.
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than retroclaw. Tarsi 1 and 2 flattened beneath and armed with numerous rod-like spines. Abdomen oval, spinnerets short.

Genotype *Gradungula sorenseni* sp. nov.

Gradungula sorenseni sp. nov.

Figs. 1, 2a-c

FEMALE

Measurements (in mm.):

Length of cephalothorax....	4.68
Width of cephalothorax.....	4.04
Length of abdomen.....	8.28
Width of abdomen.....	5.23

	FEMUR	PATELLA	TIBIA	META-TARSUS	TARSUS	TOTAL
Leg 1....	3.53	1.29	2.94	2.58	1.28	11.62
Leg 2....	3.23	1.34	3.04	2.78	1.14	11.53
Leg 3....	3.03	1.34	2.13	2.77	1.04	10.31
Leg 4....	3.94	1.48	3.59	3.78	1.43	14.22
Palp.....	2.04	0.74	1.19		1.69	5.66

Colour: Two longitudinal patches of deep yellow extend along the carapace and are separated by a median longitudinal dark brown band, which merges in front and behind with dark brown bands extending along the lateral margins. The ground colour of the abdomen is greyish brown with a median dark brown band extending down slightly more than half of the anterior dorsal surface, followed by an irregular transverse patch at three-quarters of its length. The dark brown areas are not formed by pigment but by closely spaced short black hairs. Chelicerae dark brown. Maxillae dark brown but anterior margins creamy white. Sternum dark brown with black shading on the median surface. Legs and palps banded with alternate dark and pale brown markings.

Carapace: The head region is narrower than the thoracic region, lateral margins subparallel, and relatively low but of the same height as the thoracic region. The lateral margins of the thoracic region are evenly rounded, widest between coxae 2 and 3 where the width is almost equal to the length of the carapace. A number of small setae are present on the clypeus and in the region of the eyes. A row of from 6 to 7 small setae extend back

from the lateral eyes and a similar number extend back down the median line to the fovea. The fovea is longitudinal and deep and is surrounded by small setae. Faint traces of striae can be seen on the median surface of the carapace near the fovea.

Eyes: From in front the anterior row is slightly procurved and the posterior row recurved. From above the anterior row appears strongly procurved and the posterior row straight. The ratio of the eyes AME:ALE:PME:PLE = 2:5:4:4. The AME are separated from each other by a space equal to one half and from the ALE by twice of the diameter of an AME. The lateral eyes are sub-contiguous and are raised from the surface of the carapace by a small swelling. The distance between the PME, the PME and the AME, and the PME and the PLE is in all cases equal to twice the diameter of an AME. The median ocular quadrangle is wider behind than in front in the ratio of 11:7. The height of the clypeus is slightly more than three times the diameter of the AME. AME black, remainder pearly white.

Chelicerae: These are stout, directed forward, slightly divergent. Lateral condyles are absent. There is a series of closely spaced parallel ridges on the retrolateral surface of each chelicera which has the appearance of a typical stridulating structure. The fangs are strong and evenly curved. Promargin with a row of eight strong teeth, retromargin smooth but with a row of closely spaced long setae which form a scopula (Fig. 1*d, e*).

Maxillae: (Fig. 1*b*) These do not converge over the labium. The trochanter is inserted laterally and the basal portion of the maxilla is separated from the anterior portion by a distinct groove. The anterior margin is directed obliquely inwards and is provided with a dense scopula, but a serrula is lacking.

Labium: (Fig. 1*b*) Free. Wider than long in the proportions of 14:11. Lateral margins slightly curved, anterior margin indented and provided with ten setae.

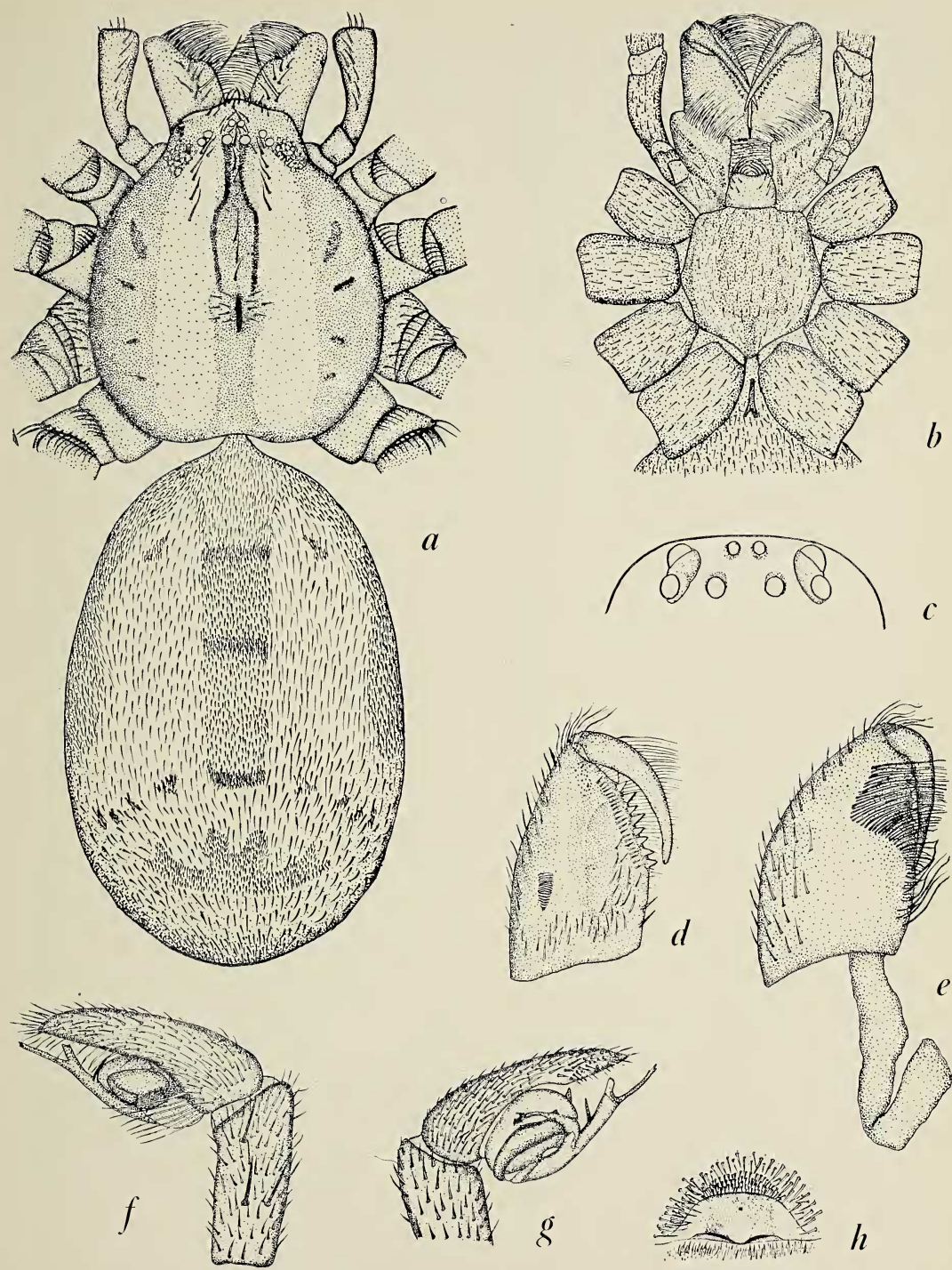


FIG. 1. *Gradungula sorenseni* sp. nov.: a, dorsal aspect of body of female; b, ventral aspect of anterior portion of body of female; c, eyes in dorsal view; d, retrolateral aspect of chelicera; e, prolateral aspect of chelicera; f, retrolateral aspect of male pedipalp; g, prolateral aspect of male pedipalp; h, epigynum of female.

Sternum: (Fig. 1*b*) Almost as wide as long, flattened, scutiform. The anterior margin is straight, lateral margins slightly rebordered, not extending laterally between the coxae. The posterior margin is broadly pointed and does not extend back between coxae 4, which are separated from each other by a distance equal to one fifth of their width.

Legs: 4.1.2.3. The superior claws of legs 1 and 2 are markedly dissimilar. The proclaw is extremely long and strongly developed, its length being equal to three-fifths of that of the tarsal segment and is smooth below except for six small teeth near the base. The reproclaw is equal to two-thirds of the length of the retroclaw and is normal in appearance, pectinate below with a row of eight to nine strong teeth (Fig. 2*b*). The inferior claw is slender and smooth, originating from a triangular plate below the superior claws. The tarsi of legs 1 and 2 are also modified. They are robust, convex dorsally but flattened beneath, with numerous rod-like spines arranged in rather irregular longitudinal rows on most of the ventral surface (Fig. 2*a*). The tarsus and claws of legs 3 and 4 are normal in structure, superior claws homogeneous, pectinate below with a row of from 10 to 11 teeth, inferior claw with a single tooth near the base.

Disposition of spines.—First leg; femur, dorsal 1p-1r-2-0-1r, prolateral 0-0-0-2-1d, elsewhere 0; patella 0; tibia, ventral 2-2-2, elsewhere 0; metatarsus, ventral 2-2-2-2; tarsus with numerous blunt spines on ventral surface as shown in Figure 2*a*. Second leg; femur, dorsal 1p-2-1r-1r-1r, prolateral 0-1d-1d-1d-1d, elsewhere 0; patella 0; tibia, ventral 1r-1r-1r, elsewhere 0; metatarsus, ventral 2-2-1p, elsewhere 0; tarsus as in leg 1. Third leg; femur, dorsal 2-1r-2-1r-2, prolateral 1d-0-1d-1d-1d, elsewhere 0; patella, prolateral 1, retrolateral 1, elsewhere 0; tibia, dorsal 1p-0-2-2, ventral 2-1p-2-2, prolateral 2-2-2-2, retrolateral 1d-1d-0-0; metatarsus, dorsal 2-2-2-2, ventral 2-2-2-2, prolateral 2-2-

2-0, retrolateral 1d-1d-1d-2. Fourth leg; femur, dorsal 2-1p-2-1r-2, ventral 0, prolateral 1d-0-1d-1d-1d, retrolateral 0; patella, retrolateral 1, elsewhere 0; tibia, dorsal 1p-1p-1r-1r, ventral 2-0-1p-0, prolateral 2-2-2-0, retrolateral 1d-1d-1d-0; metatarsus, dorsal 2-2-2, ventral 2-2-2, prolateral 2-2-2, retrolateral 2-1d-1d; tarsus 0.

Trichobothria are present on the tibia of all legs and the metatarsus of legs 1 and 4. First leg, tibia with two distal, metatarsus with one distal. Second leg, tibia three, metatarsus none. Third leg, tibia three, metatarsus none. Fourth leg, tibia six, metatarsus, one distal.

Palps: Slightly longer than the tibia of leg 1. Closely clothed with both short and long smooth hairs. Spines.—Femur, dorsal 1-1-1; patella, dorsal 1-1-1; tibia, dorsal 1-0-1, ventral 0, prolateral 1-1-0, retrolateral 0-1-0. There is a row of five trichobothria on the dorsal surface of the tibia, increasing in size anteriorly. The tarsal claw is strong and is pectinate below with a single row of nine teeth.

Abdomen: Ovoid, entire surface covered with small serrate setae. The dark markings on the dorsal and lateral surfaces are formed by numerous small hairs which in these regions are darker in colour and more closely spaced. Two pairs of book lungs are present, posterior pair more closely spaced than anterior pair. The spiracles of the anterior pair open from the abdomen at about 0.57 of its length. The epigynum is lightly sclerotic and appears as shown in Figure 1*b*. There are six spinnerets, anterior and posterior pairs each of two segments, somewhat conical, and well separated at their bases. The median spinnerets are one-segmented and are closely spaced. A small colulus is present.

MALE

Measurements (in mm.):

Length of cephalothorax....	4.58
Width of cephalothorax.....	4.09
Length of abdomen.....	5.57
Width of abdomen.....	3.08

	FEMUR	PATELLA	TIBIA	META-TARSUS	TARSUS	TOTAL
Leg 1....	4.23	1.64	3.44	3.53	1.43	14.27
Leg 2....	4.09	1.54	3.53	3.23	1.24	13.63
Leg 3....	3.79	1.38	3.03	3.54	1.23	12.97
Leg 4....	4.68	1.59	4.08	4.88	1.53	16.76
Palp....	2.29	0.78	1.54		2.04	6.65

The male is very similar to the female in colouration and many structural features. Only the following characters need description.

Eyes: Ratio of AME:ALE:PME:PLE = 5:8:8:7. The AME are separated from each other by a distance equal to 0.6 and from the ALE by 1.6 of the diameter of the AME. The ALE and PLE are sub-contiguous and are placed on a low protuberance. The PME are separated from each other and from the AME by a space equal to 1.2 of the diameter of the AME. The PME are separated from the PLE by a space equal to 1.6 of the diameter of the AME. The median ocular quadrangle is wider behind than in front in the proportions of 11:7.

The chelicerae are as in the female and the series of ridges on the retrolateral surfaces.

Legs: The number and distribution of the trichobothria is as recorded for the female. The tarsal claws are also similar in structure. Disposition of spines.—First leg; femur, dorsal 0-0-2-2-2, elsewhere 0; patella 0; tibia, ventral 1r-1r-1r-0, prolateral 0-0-0-1d, elsewhere 0; metatarsus, ventral 2-2-2-2, elsewhere 0; tarsus as in female. Second leg; femur, dorsal 2-2-2-2-2, prolateral 1d-0-1d-0-0, elsewhere 0; patella 0; tibia, ventral 1p-2-2-2, elsewhere 0; metatarsus, ventral 2-2-2-2, elsewhere 0; tarsus similar to female but with a thick scopula on the retromargin. Third leg; femur, dorsal 2-2-2-2-2, prolateral 0-1d-1d-1d-1d, elsewhere 0; patella, retrolateral 1, elsewhere 0; tibia, dorsal 2-1p-2-2, ventral 1d-0-1d-0, prolateral 1d-1d-1d-1d, retrolateral 1d-0-1d-0; metatarsus, dorsal 1p-2-1r-2, ventral 2-2-2-0, prolateral 1d-1d-1d-2, retrolateral 2-0-2-1d; tarsus 0. Fourth leg; femur, dorsal 2-1r-2-2-2, prolateral 1d-2-1d-1d-1d, elsewhere 0; patella,

prolateral 1, retrolateral 1, elsewhere 0; tibia, dorsal 2-2-2-2, ventral 2-1p-2-0, prolateral 1m-1m-1m-0, retrolateral 1d-0-1d-1d; metatarsus, dorsal 2-2-2-2, ventral 2-2-2-2, prolateral 2-1d-2-2, retrolateral 2-1d-1d-2; tarsus 0.

Palps: (Fig. 1f, g) There are five trichobothria in a single row along the dorsal surface of the tibia. The tarsal segment is slightly longer than the tibia. The genital bulb is relatively simple. Near the anterior margin a strong lateral branch curves back over the surface of the bulb, and terminates in a sharp curved tooth which rests against a hooked process rising from the prolateral surface. There is also a small tooth on the anterior surface of the lateral branch at about one half of its length. A further more slender branch is directed inward toward the tarsus immediately beyond the bulb. The embolus then widens to a point halfway between the anterior surface of the bulb and the tip of the tarsal segment. The alveolus is oval in outline and is situated on the middle of the ventral surface. There is a fringe of long hairs along the retromargin of the alveolus which extends over the surface of the bulb.

TYPES: *Holotype*, female, Franz Josef, Westland, from under log, 30 April, 1951, R. R. Forster (C.M.A. 1042); *allotype*, male, same data (C.M.A. 1043); *paratypes*—one female, same data as holotype (C.M.A. 1044); Fox Glacier, Westland, September, 1951, M. Warren, two females (C.M.A. 1045); Halfmoon Bay, Stewart Island, January, 1952, O. Allan, two immature females (C.M.A. 1049); Ore-puki, west side of Longwood Range, September, 1948, J. H. Sorensen, one immature female (C.M.A. 1055); Stillwater Base Camp, Caswell Sound, March 13, 1949, R. K. Dell, two males, one immature (D.M. 2/1014); Leslie Clearing Track, Caswell Sound, March 16, 1949, R. K. Dell, one male, one female (D.M. 2/1015); Okarito, Westland, December 7, 1949, R. R. Forster, one male (C.M.A. 1048); same locality, April 26, 1951, R. R.

Forster, one immature female (C.M.A. 1051); Moana, Westland, March 10, 1950, R. R. Forster, two males, one immature (C.M.A. 1047); Kiwi Valley, Lewis Pass, November 14, 1949, R. R. Forster, one immature female (C.M.A. 1046); Lake Taylor, Canterbury, April 14, 1952, R. R. Forster, one female (C.M.A. 1054); Woodpecker Bay, Westland, January 22, 1950, R. R. Forster, one immature female (C.M.A. 1052); South Terrace, Karamea, January 21, 1950, R. R. Forster, three immature males, one immature female (C.M.A. 1053); Oparara, Karamea, January 24, 1950, R. R. Forster, one immature male, three immature females (C.M.A. 1050). Paratype specimens are also located in collections of The American Museum of Natural History, New York, Professor B. J. Marples, University of Otago and Professor V. V. Hickman, University of Tasmania.

Gradungula woodwardi sp. nov.

Fig. 2d-g

Although the material on which this species is based consists of only three immature specimens, two of which are probably less than half grown, the characters discussed below clearly separate this species from *G. sorenseni*. It would be of considerable interest to have adult material available for description in view of the close relationship of this species to the New Zealand form.

FEMALE (Immature specimen, probably two moults from maturity)

Measurements (in mm.):

Length of cephalothorax . . .	2.36
Width of cephalothorax	1.76
Length of abdomen	2.91
Width of abdomen	1.98

	FEMUR	PATELLA	TIBIA	META-TARSUS	TARSUS	TOTAL
Leg 1 . . .	1.92	0.74	1.48	1.18	0.89	6.21
Leg 2 . . .	1.98	0.60	1.46	1.04	0.88	5.96
Leg 3 . . .	1.62	0.73	1.18	1.31	0.59	5.43
Leg 4 . . .	2.09	0.75	1.63	1.76	0.81	7.04
Palp	0.86	0.43	0.66		0.82	2.77

The colour pattern of the cephalothorax is similar to that of *sorenseni*, but the abdomen is uniform greyish-brown and lacks the median black patches. The legs are provided with alternate dark and pale brown bands.

The structure of the sternum, labium, and maxillary lobes are as in *sorenseni*. The chelicerae are also similar in structure although the teeth on the promargins appear to be relatively smaller.

Eyes: The ratio of the AME:ALE:PME:PLE = 5:9:6:6. The AME are separated from each other by 0.4 of their diameter and from the ALE by 1.2 of this distance. The lateral eyes are contiguous and are placed on a common, low tubercle. The PLE are separated from the PME by 1.2 of the diameter of the AME. The PME are separated from each other by 1.6 and from the AME by 0.6 of the diameter of the AME. The median ocular quadrangle is wider behind than in front in the ratio of 10:6. The posterior width is also greater than the length of the quadrangle in the ratio of 10:7.

Legs: Spines are distributed as follows.—First leg; femur, dorsal 1.1.1.0.0, prolateral 0.0.0.1.1, elsewhere 0; patella 0; tibia, ventral 2.2, elsewhere 0; metatarsus, dorsal 0, ventral 0.0.0.2, prolateral 1.1.1.1, retrolateral 1.1.1.1. Second leg; femur, dorsal 1.1.1.0.0, prolateral 0.0.1.1.1, elsewhere 0; patella 0; tibia, ventral 1p.1p.1p, elsewhere 0; metatarsus, ventral 1.1.1.2, prolateral 0.0.0.1. Third leg; femur dorsal 1.1.1.1.1, ventral 0, prolateral 0.1d.1d.1d.1d, retrolateral 1d.1d.1d.1d.1d; patella, prolateral 1, retrolateral 1, elsewhere 0; tibia, dorsal 0.1.1.0, ventral 2.2.2.0, prolateral 1.1.1.1v, retrolateral 1.1.1.1v; metatarsus, dorsal 0.0.1.1, ventral 1.1.1.1, prolateral 2.0.2.1, retrolateral 2.0.2.1. Fourth leg; femur, dorsal 1.0.1.0.1, ventral 0, prolateral 1d.0.0.1d.1d, retrolateral 0.0.0.0.1d; patella, prolateral 1, ventral 1; tibia dorsal 1.1.1.0.1, ventral 0.2.0.2.2, prolateral 1d.0.1d.0.1, retrolateral 1d.0.0.0.1; metatarsus, dorsal 1.0.0.0.2, ventral 2.2.0.2, prolateral 0.10.1.0, retrolateral 0.0.1.0.1.

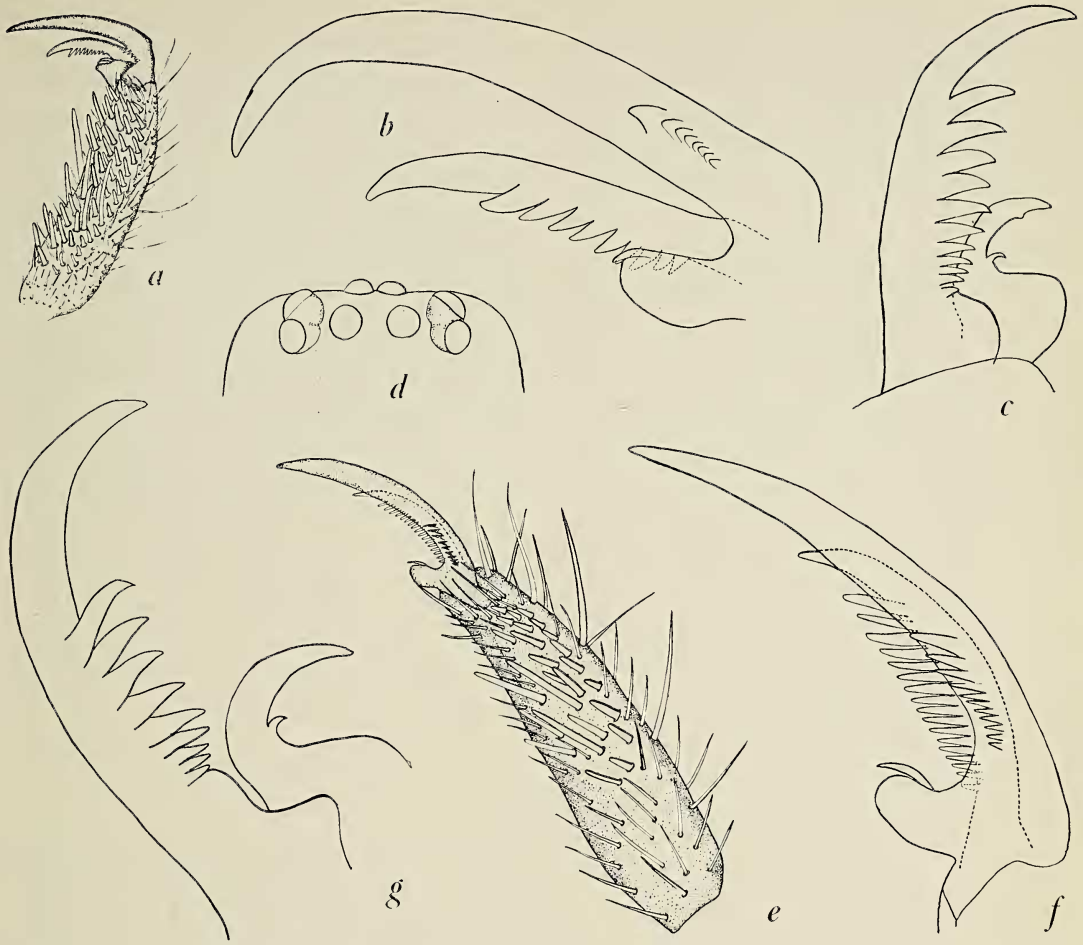


FIG. 2. Structural details of species of *Gradungula*. a-c, *Gradungula sorenseni* sp. nov.: a, tarsus and claws of first leg of female; b, tarsal claws of first leg of female; c, tarsal claws of fourth leg of female, showing one superior claw. d-g, *Gradungula woodwardi* sp. nov.: d, eyes in dorsal view; e, tarsus and claws of first leg; f, tarsal claws of first leg; g, tarsal claws of fourth leg, showing one superior claw.

Trichobothria are distributed as follows.—First leg; tibia, 1.2.1.2; metatarsus, 1 distal. Second leg; tibia 1.2.1.2; metatarsus, 1 distal. Third and fourth legs with 6 pairs on tibia and 1 distal on metatarsus.

The spines on the ventral surface of tarsi 1 and 2 are not as numerous as in *sorenseni* and are practically limited to the distal half of the segment. The tarsal claws of legs 1 and 2 are modified as in *sorenseni* but the teeth on the ventral surface of the two superior claws are more numerous. There are from 11 to 12

on the proclaw and 17 to 18 on the retroclaw (Fig. 2f). The superior claws of legs 3 and 4 are homogeneous, with nine strong teeth (Fig. 2g).

Palp: As in *sorenseni* but with four trichobothria on the dorsal surface of the tibia.

TYPES: *Holotype*, female (immature), Mount Hobwee, Lamington Plateau, South Queensland, from leaf mould gathered in rain forest, 27 September, 1953, T. E. Woodward; *Paratypes*—Mount Merino, Lamington Plateau,

from moss and lichens, 27 September, T. E. Woodward, one immature female; Binna Burra, Lamington Plateau, from leaf mould gathered in rain forest, 28 September, T. E. Woodward, one immature female. The specimens are at present housed in the Canterbury Museum.

The description given above will need considerable amplification when mature specimens are available for examination but the structure of the tarsal claws is sufficient to separate this species from *sorenseni* as this has been found to be constant throughout the range of specimens of the latter species which have been examined, both adult and immature. The occurrence of these two closely related species, separated by over a 1,000 miles of open sea, is of great interest and adds yet another example to the already lengthy list showing the close affinity of the New Zealand fauna with a section of the Australian fauna. If, as many geologists believe, the last possible land link between these two areas was in the late Mesozoic, the rate of speciation for many groups must be extremely slow.

NOTES ON THE BIOLOGY OF *Gradungula sorenseni*

These spiders are to be found in the forested areas of the west coast of the South Island of New Zealand and also on Stewart Island. In all these areas the rainfall is high and the forest is wet continuously. It would appear that the Australian species, also, is limited in distribution to similar forest conditions.

The spiders are nocturnal, and are found during the daylight hours sheltering beneath logs or small pieces of bark and twigs on the forest floor. At such times they are usually sluggish and the legs are held close to the body. While thus quiescent the abdomen is usually covered with a number of small droplets of water which cling to the hairs. Field observations supported by laboratory experiments would indicate that the species is

extremely susceptible to dryness and requires a high relative humidity for survival.

It is noteworthy that no sign of any silken web, or in fact any silken structure at all, has been found associated with the spiders in the field. Observations carried on over a period of six months under laboratory conditions with both males and females have shown only the occasional use of a drag line. Food in the nature of flies and other small insects was readily accepted and was captured by hunting, although the distance from which the prey was observed was short, rarely more than 5 or 6 inches. The use of the claws of the first two pairs of legs in the capture of prey was only observed in one instance when the superior claws were flexed against the tarsal segment to hold a harvestman (*Nuncia* sp.), but it was released without being killed.

No mating behavior has been observed and the appearance and structure of the egg-sacs and sperm web are unknown.

NOTES ON THE INTERNAL ANATOMY OF *Gradungula sorenseni*

Digestive System: The thoracenteron is of the "classic" type, with four pairs of unbranched diverticulae extending laterally and downwards into the coxae of the four pairs of legs. There are from 12 to 14 large multicellular pyriform glands within each maxilla which open from a circular sieve plate on the inner margin near the base.

Excretory System: A pair of biramous Malpighian tubes open into the gut anterior to the stercoral pouch. The coxal glands are well developed. There is a single outlet for each gland situated at the base of the coxae of the first pair of legs. The labyrinth runs back from a terminal saccule as a straight tube, into which a small accessory saccule opens at about the level of the third pair of legs. The labyrinth then distends above coxa 4 before turning down to run back to the opening on the coxae of the first pair of legs. Dorsal and ventral "dips" are present on this latter portion in the region of coxae 3 and 4.

Poison Glands: These are endocephalic. They are cylindrical and are bent down in the region of the second pair of coxae to run forward for a short distance before terminating bluntly.

Silk Glands: In the female only cylindrical and pyriform glands appear to be present. A large number of long cylindrical glands extend back above and lateral to the gut and appear to open from both the median and posterior spinnerets. Numerous small pyriform glands and a group of three large pyriform glands open from each anterior spinneret. In the male all spinnerets appear to be supplied from small pyriform glands while a small bunch of much convoluted cylindrical

glands opens from each anterior spinneret.

Respiratory System: Two pairs of lung books are present. The anterior pair occupies the normal position and has from 50 to 54 lamellae. The posterior pair are smaller and more closely spaced and each is composed of from 21 to 22 lamellae.

Circulatory System: The heart is large and is supplied with four pairs of ostia.

REFERENCE

- PETRUNKOVITCH, A. 1933. An enquiry into the natural classification of spiders, based on a study of their internal anatomy. *Conn. Acad. Arts and Sci., Trans.* 31: 299-389.